

1 A LIGHTING FIXTURE

2  
3 CROSS-REFERENCE TO RELATED APPLICATION

4 This application claims the benefit, under 35 U.S.C. §119(e), of U.S.  
5 Provisional Application No. 60/201,489; filed May 3, 2000.

6  
7 FEDERALLY-SPONSORED RESEARCH OR DEVELOPMENT

8 Not Applicable

9  
10 BACKGROUND OF THE INVENTION

11 The present invention relates to a lighting fixture for projecting a beam  
12 of light and for use for spot lighting in connection with theater stages, cinema  
13 and television studios and the like, the fixture comprising:

14 a light source arranged at one end of a housing having a light beam exit  
15 aperture at the opposite end thereof, the light source and aperture being  
16 arranged generally concentric with a longitudinal or optical axis of the  
17 lighting fixture,

18 light beam influencing means at least comprising one or more,  
19 preferably four, beam-shaping blades and preferably also comprising other  
20 light influencing means such as one or more lenses and/or an iris and/or a  
21 pattern or gobo, for influencing a light beam emitted by the light source and  
22 being arranged along the path of the light beam along said longitudinal axis  
23 through the housing from the light source to the aperture, and

24 adjustment means for adjusting the position of at least said one or more  
25 beam-shaping blades and preferably of all said influencing means relative to  
26 said longitudinal axis.

27 The purpose of a lighting fixture as defined above is to produce a well-  
28 defined light beam or light cone with a geometry, angle of conicity and focal  
29 point that may be altered manually or by remote control.

1 A lighting fixture will normally comprise a light source, a reflector, a  
2 beam-shaping gate with beam-shaping blades, a pattern or gobo, an iris, a  
3 focusing lens, a zoom lens and a color filter as well as a suspension structure  
4 allowing the lighting fixture to be pivoted vertically and horizontally.

5 The visible part of the light emitted by the light source is collected by  
6 the reflector and is sent towards the iris, the gobo and the beam-shaping gate  
7 as a parallel light beam. The infrared part of the radiation from the light  
8 source passes through the dichroic coating of the reflector and impinges on  
9 the inner surface of the housing surrounding the light source, the heat being  
10 transported to the outer surface of the housing having cooling ribs for emitting  
11 the heat to the surrounding atmosphere.

12 It is often necessary to be able to determine the geometry of the light  
13 beam, and this is achieved by means of the zoom lens varying the angle of  
14 conicity of the light cone and by shaping or cutting off the periphery of the  
15 light beam by means of the beam-shaping gate with beam-shaping blades so  
16 as to obtain geometrical figures such as squares, triangles, trapezoids etc. The  
17 lenses project the light out through the aperture of the housing opposite the  
18 light source and through the color filter at the front end of the lighting fixture.  
19 It is important that the different elements influencing the shape and other  
20 characteristics of the light beam function as precisely as possible even when  
21 being influenced by the heat radiated from the light source and not removed  
22 by means of the dichroic reflector. This entails that the location and the  
23 configuration of the adjustment means for the beam-shaping blades, the gobo  
24 and iris are such that any bending caused by the heat influence from the light  
25 beam be kept at a minimum.

26 Lighting fixtures of this type are often arranged in places where it is  
27 difficult to access them manually and it is therefore of great importance that  
28 the adjustment means for adjusting the above-mentioned beam influencing  
29 means be as easily accessed and as flexible as possible when manual operation

1 of the adjustment means is required.

2 U.S. Patent No. 5,345,371 discloses a lighting fixture of the type in  
3 reference where the four beam-shaping blades or shutters are slidingly  
4 insertable in slots from outside, the shutters being radially adjustable by  
5 gripping a holder for each shutter and sliding the shutter in or relative to the  
6 optical axis. The shutters may also be tilted manually to a certain extent.  
7 However, a further tilting possibility is achieved by allowing the portion of  
8 the fixture containing the shutters to be rotated as a unit around the axis. This  
9 is a complicated solution and needs manual access to all holders of the  
10 shutters as well as manipulation of the rotation means for rotating part of the  
11 fixture. Motorization for remote control of this design will be very  
12 complicated and costly.

13 U.S. Patent No. 4,890,208 discloses a lighting fixture of the type in  
14 reference where four shutters are arranged for motorized displacement radially  
15 toward the optical axis and motorized tilting by means of rack and pinion  
16 mechanisms. This solution is complicated and has only limited tilting  
17 capability, i.e. displacement capability circumferentially around the axis.  
18 Furthermore this solution is not well suited for manual operation.

19

## 20 SUMMARY OF THE INVENTION

21 It is an object of the invention to provide a lighting fixture of the type  
22 indicated, wherein access for manual operation is convenient and not  
23 dependent on the orientation of the lighting fixture, wherein motorization for  
24 remote control may be established in a simple and reliable manner and  
25 wherein the range of displacement circumferentially around the optical axis is  
26 as great as possible.

27 According to the invention this object is achieved by at least the  
28 adjustment means corresponding to said one or more beam-shaping blades  
29 and preferably all the adjustment means are arranged for rotation around said

1 longitudinal axis and are connected to a respective influencing means such  
2 that rotation of the adjustment means around said longitudinal axis adjusts the  
3 position of the respective influencing means relative to said longitudinal axis.

4 Hereby the adjustment means may be accessed from practically any  
5 angle, and no limit to the adjustment possibilities in circumferential direction  
6 is inherent.

7 In the currently preferred embodiment the adjustment means comprise  
8 an annular body arranged with the axis thereof substantially coinciding with  
9 said longitudinal axis. This is a particularly simple and effective embodiment.

10 In the currently preferred embodiment of the invention the annular  
11 body comprises an outer rim configured for being engaged for applying  
12 rotational force thereto, the surface of said outer rim being provided with  
13 friction enhancing means such as roughening means, rubber surfacing,  
14 projections or teeth. Hereby manual and remote operation of the adjustment  
15 means is particularly simple and efficient.

16 Advantageously, the fixture further comprises one or more electrical  
17 motors connected to a respective drive wheel engaging said outer rim of a  
18 respective annular body for applying a rotational force thereto, and preferably  
19 the drive wheel is a gear having teeth, and the respective outer rim engaged by  
20 a respective gear is provided with teeth for meshing with the teeth of said gear  
21 when said gear rotates.

22 For use in remote control of the lighting fixture with pre-determined  
23 positions of the light influencing means, it is advantageous that the annular  
24 body be provided with a position indicating means for indicating the angular  
25 position of the annular body relative to said longitudinal axis. Hereby a  
26 reference point for the remote control operation is available, thereby  
27 eliminating errors and inaccuracies.

28 Advantageously, the position indicating means comprises an element  
29 that may be remotely sensed such as a magnet or a gap, and the fixture further

1 comprises remote sensing means for sensing the angular position of said  
2 element relative to said longitudinal axis.

3       So as to obtain the greatest flexibility of adjustment and the greatest  
4 range of adjustment, the adjustment means for each of the one or more beam-  
5 shaping blades comprises radial adjustment means for adjusting the position  
6 of the blade radially relative to said axis, and circumferential adjustment  
7 means for adjusting the position of said blade circumferentially around said  
8 axis.

9       A particularly simple and efficient as well as accurate embodiment of  
10 the light fixture according to the invention is provided by the adjustment  
11 means for each of the one or more beam-shaping blades comprising two  
12 adjacent co-central annular bodies or rings each connected to one point of  
13 the blade such that relative rotation of the two rings alters the radial position  
14 of the blade.

15       In the currently preferred embodiment, the rings comprise guiding  
16 tracks recessed into the lateral surface of each ring facing the other ring, and  
17 each blade comprises a body extending generally transversely to said axis and  
18 two arms extending generally parallel to said axis, the arms each being  
19 provided with sliding connecting means for connecting the respective arm to  
20 each of the rings and being adapted for being slidably received in a guiding  
21 track in each of said rings.

22

## 23                   BRIEF DESCRIPTION OF THE DRAWINGS

24       In the following description, preferred embodiments of a lighting  
25 fixture according to the invention will be described in detail, solely by way of  
26 example, with reference to the accompanying drawings, where:

27       Fig. 1 is an isometric elevational view of a lighting fixture according to  
28 the invention for manual operation;

29       Fig. 2 is a partially cut-away view of the lighting fixture in Fig. 1

1 illustrating the internal configuration of the lighting fixture;

2 Fig. 3 is a schematic cross-sectional view of the lighting fixture of Figs  
3 1 and 2, the cross-section being taken along a vertical plane containing the  
4 longitudinal or optical axis of the lighting fixture;

5 Fig. 4 is an enlarged scale view of the left-hand part of Fig. 3;

6 Fig. 5 is an isometric elevational view of the bottom half of the frame  
7 of the lighting fixture of Figs. 1 and 2;

8 Fig. 6 is an exploded view of the beam-shaping blades and adjustment  
9 rings of the fixture in Figs. 1 and 2;

10 Fig. 7 is an axial end view of the blades and rings shown in Fig. 6 in  
11 nested assembled condition;

12 Figs. 8 and 9 are schematic axial end views corresponding to Fig. 7  
13 illustrating the adjustment of the beam-shaping blades of Figs. 6-7;

14 Fig. 10 is an illustration of the constructive principles of the guiding  
15 tracks in the adjustment rings for the beam-shaping blades;

16 Fig. 11 schematically illustrates an alternative embodiment of the  
17 beam-shaping blades and the adjustment mechanisms therefor;

18 Fig. 12 shows an isometric partly exploded view in larger scale of the  
19 position adjustment mechanism for the lenses shown in Fig. 2; and

20 Fig. 13 shows an enlarged view of a detail of the construction shown in  
21 Fig. 12.

22

## 23 DETAILED DESCRIPTION OF THE INVENTION

24 Referring now to Figs 1-5, a lighting fixture 1 according to the  
25 invention is suspended in a suspension fitting 2 having an aperture 3 for  
26 fixing the fitting 2 pivotably to a support structure (not shown) in a theater, a  
27 television studio or the like. The fitting 2 is pivotably attached to the body of  
28 the lighting fixture 1 at 4, the attachment point being adjustable by sliding the  
29 pivot attachment point 4 in a slit 5 in a frame 6 so as to compensate for change

1 of balance because of insertion or removal of different elements in the  
2 lighting fixture 1.

3 The lighting fixture 1 may thus be manually pivoted around two  
4 mutually substantially orthogonal axes allowing the direction of a light beam  
5 emitted by the fixture to be any desired direction.

6 If it is desired to be able to remotely control the direction of the beam,  
7 the pivoting action may be achieved by means of remotely controlled  
8 electrical motors in many different ways that will be obvious to those skilled  
9 in the art.

10 The frame 6 is generally U-shaped having two arms supporting the  
11 body of the lighting fixture 1 between said arms. A series of toothed rims 7-18  
12 are arranged for rotation around a longitudinal or optical axis 19 (see Fig. 3).  
13 The teeth of the toothed rims are configured such that the teeth of a pinion of  
14 a drive unit may engage and mesh therewith if the light beam influencing  
15 facilities of the lighting fixture operated by rotation of the bodies 7-18 are to  
16 be motorized for remote control.

17 In the manually operated embodiment shown in Figs 1-4, the teeth of  
18 the toothed rims serve as a roughening element of the surface of the rim of  
19 each of the annular bodies 7-18 such that good frictional engagement between  
20 the fingers of a hand and the toothed rims or annular bodies 7-18 may be  
21 achieved for rotating the annular bodies 7-18 manually.

22 Such roughening of the rim surface may be achieved in many other  
23 ways such as scoring of the surface or coating with rubber or provision of  
24 small projections etc.

25 In such case and if motorization of the rotation of the bodies 7-18 is  
26 desired, then a frictional surface engagement of for instance the surface of a  
27 rubber coated drive wheel driven by an electrical motor with the roughened  
28 rim surface may be provided for instead of the meshing of the teeth of a  
29 pinion with teeth of the rim of the annular body.

1 A light source or lamp 20 emits a light beam composed of individual  
 2 light beams such as illustrated at 20a, the visual portion thereof being  
 3 reflected by a dichroic reflector 21 through a focusing lens 22 and a zoom lens  
 4 23 and out of the lighting fixture through an aperture 24 in the housing 25 of  
 5 the fixture 1, the light beam 20a traveling through a color filter (not shown)  
 6 arranged in four color filter holders 26 that may be pivoted around pivots 27  
 7 so as to allow a color filter to be inserted and removed in the holders 26 in any  
 8 of four directions determined by the four holders 26. Hereby the color filter  
 9 may be inserted and removed from the best angle for manual access for a  
 10 given orientation of the housing 25. The entire light beam projected by the  
 11 lighting fixture is of course composed of a plurality of light beams analogous  
 12 to individual light beam 20a.

13 The infra red portion of the light beam 20a is transmitted through the  
 14 dichroic reflector 21 to cooling ribs 22 in a manner well known in the art so as  
 15 to reduce the heat distortion of light beam influencing elements, as described  
 16 below, that are arranged along the path of the light beam from the light source  
 17 20 to the exit aperture 24.

18 These light beam influencing elements comprise an iris 28 connected  
 19 to the annular body 7, a pattern or gobo 29 connected to the annular body 8,  
 20 four beam-shaping blades 30, 31, 32 and 33 connected to the pairs of annular  
 21 bodies, 9 -10, 11-12, 13 -14 and 15 -16, respectively, the focusing lens 22  
 22 connected to the annular body 17, and the zoom lens 23 connected to the  
 23 annular body 18.

24 The annular bodies or rings 7-18 are connected in different manners to  
 25 the respective light beam influencing elements 22, 23 and 28-33 so that the  
 26 position of these elements may be altered relative to the axis 19, and thus the  
 27 light beam, by rotating the rings around said axis. The individual connections  
 28 between the individual rings and the respective elements will be described  
 29 more in detail below.



1           The feature of being able to alter the position of the light beam  
2 influencing elements, and particularly of the light beam shaping blades 30-33,  
3 by means of rotating the corresponding rings allows the position alteration to  
4 be carried out manually from a convenient angle of approach for a given  
5 orientation of the housing 25. As the rim surface of each of the rings 7-18 may  
6 be engaged manually at most of the extent of the circumference thereof, the  
7 manual adjustment of the position of a respective light beam influencing  
8 element may be performed from the most convenient angle of approach to the  
9 housing 25. Furthermore, the manual adjustment may be carried out with one  
10 hand which is important, as the fixture is often located such that access with  
11 both hands is difficult and perhaps impossible.

12           Hereby the lighting fixture according to the invention does not have the  
13 disadvantages of known lighting fixtures where the adjustment means for  
14 adjusting the position of a light beam shaping blade may be very  
15 inconveniently located relative to the position of the person operating the  
16 lighting fixture so that the person for instance has to reach around the lighting  
17 fixture housing to access the adjustment means thereby risking being burned  
18 on the hot housing surface and rendering rapid and precise position  
19 adjustment difficult and perhaps impossible.

20           This advantage can also be obtained by rotational means other than  
21 rings with a rim surface for being engaged manually or mechanically.  
22 Elements having a plurality of radially extending spokes spaced  
23 circumferentially for being engaged at the ends thereof by fingers of a hand or  
24 a motorized driving means may also be used. A circumferentially disposed  
25 endless belt arranged for substantially circular movement around the  
26 longitudinal axis may also be utilized instead of the illustrated rings. All  
27 means allowing access along a major part of the circumference of the housing  
28 and rotational frictional engagement by fingers or a motorized drive unit may

1 be used to allow such convenient access to the adjustment means for altering  
2 the position of the beam influencing elements.

3 The feature of altering the position of the light influencing elements by  
4 rotational means also entails simple and reliable establishment of a certain  
5 adjustment setting of a respective influencing means such that pre-  
6 programmed settings may be set up for certain lighting requirements knowing  
7 that it will be simple, quick and reliable to achieve such settings either  
8 manually or remotely under difficult conditions, for instance during the course  
9 of a theater show where adjustments in the dark are necessary.

10 A further advantage is obtained by the shown structure according to the  
11 invention in that the construction is such that no light is emitted from the  
12 interior of the fixture except through the aperture 24, and all adjustments of  
13 the light beam influencing elements may be carried out without creating a  
14 light emission slit or aperture. Hereby, the disadvantage of all known lighting  
15 fixtures that light "leaks" therefrom is eliminated which is of great value,  
16 particularly for theater use.

17 Referring again to Figs. 1- 5, the frame 6 is constituted by two identical  
18 halves 6a and 6b abutting each other at 6c. The rings or annular bodies 7-18  
19 are rotatably and slidingly supported in annular grooves 34 in annular support  
20 rings 35 by means of annular projections or ridges 36 slidingly received in the  
21 annular grooves 34. The support rings 35 are each constituted by half a ring  
22 fixedly attached to or made in one piece with one half of the frame 6, for  
23 instance 6a (see Fig. 1). In other words each of the frame halves 6a and 6b is  
24 fixedly attached to or integral with a series of half rings 35 as shown in Fig.  
25 5, where the bottom half 6b of the frame 6 is shown with the corresponding  
26 half rings 35.

27 When assembling the lighting fixture 1, the adjustment rings 7-18 with  
28 corresponding beam influencing elements 22, 23 and 28-33 are arranged in  
29 the bottom half 6b of the frame with corresponding half rings 35 such that the

1 ridge 36 of each adjustment ring is received in the corresponding groove 34 of  
 2 the respective half ring 35 of the bottom frame half 6b. Thereafter the top half  
 3 6a of the frame 6 with corresponding half rings 35 is placed abutting the  
 4 bottom half 6b at 6c such that the ridge 36 of each adjustment ring is received  
 5 in the corresponding groove 34 of the respective half ring 35 of the top frame  
 6 half 6a. The adjustment rings 7-18 will thus be slidingly and rotationally  
 7 supported along the entire circumference thereof by the corresponding rings  
 8 35.

9 Each of the adjustment rings or annular bodies 7-18 may then be  
 10 rotated manually or by means of suitable mechanical means by applying a  
 11 tangential force to the rim of the respective adjustment ring whereby the ridge  
 12 36 thereof slides in the respective annular groove 34 of the respective support  
 13 ring 35. The material of the ridges 36 and the grooves 34 are chosen such that  
 14 frictional sliding resistance is kept at a minimum. The support rings 35 may  
 15 be made of cast aluminum, and the adjustment rings may be made of glass-  
 16 fiber reinforced plastic. The ridges 36 are made of a low frictional material  
 17 such as PTFE (marketed, for example, under the trademark "TEFLON"), a  
 18 ring of said material being embedded in the lateral surface of the  
 19 corresponding adjustment ring. Hereby the frictional sliding resistance  
 20 between the low friction material and the cast aluminum will be low, and the  
 21 adjustment rings may consequently be rotated by applying a relatively small  
 22 tangential force to the rim thereof.

23 Each of the adjustment ring pairs 9/10, 11/12, 13/14 and 15/16 carries  
 24 a respective light beam shaping blade 33, 32, 31 and 30, respectively, by  
 25 means of pairs of arms 33a,b, 32a,b, 31a,b and 30a,b, respectively, held by the  
 26 adjustment ring pairs in a manner described more in detail below. So that the  
 27 two rings of each ring pair can rotate relative to one another, a low friction  
 28 material ring 37 is arranged between each pair of adjustment rings as  
 29 illustrated in Figs. 4 and 6.

3           The blades 30-33 are nested as illustrated in Figs. 4, 6 and 7, each  
4 blade 30-33 being carried by a pair of opposed arms, 30a-33a and 30b-33b,  
5 respectively. It is important that the blades 30-33 are located as axially close  
6 to each other as possible so as to achieve a sharp cut-off boundary of the light  
7 beam all around the circumference thereof which only can be achieved if the  
8 blades are arranged such that there is no substantial distance between them in  
9 the axial direction of the housing. This is particularly well illustrated in Figs. 3  
10 and 4 where it is evident that the spacing of the blades in the direction of the  
11 axis 19 is slight.

The arrangement shown also has the advantage that the axial distance between the beam-shaping blades 30-33 and the iris 28 as well as the gobo or pattern 29 is small so that a good sharpness or quality of the influence of the blades, the iris and the gobo on the light beam may be obtained simultaneously because of the small axial distance covered by all said elements.

The blades 30-33 are shaped as shown in Figs. 6-8 having a generally elliptical planar body 38 with an aperture 39 having a periphery comprising a curved portion 40 and linear portions 41, 42 and 43, said periphery serving as the beam cut-off edge of the blade body 38. This is illustrated in Fig. 7 where the peripheries of the apertures 39 of the four bodies 38 of the blades 30-33 define the periphery of the beam shaping aperture 44. A multitude of different shapes of the aperture 44 may be achieved by a combination of a rotation of the different blades 30-33 around the axis 19 with a displacement of said blades 30-33 radially relative to said axis 19.

The radial displacement of the individual blades 30-33 is illustrated in Figs. 8-9 where the periphery portion 42 of blade 33 is shown in Fig. 8 at the maximum radial distance from the axis 19 and in Fig. 9 at the minimum radial

1 distance from said axis 19. The rotational displacement is achieved by  
 2 rotating the ring pair 9/10 carrying the blade 33 around the axis 19.  
 3 Combinations of the radial and the rotational displacement of each blade  
 4 allow the creation of a great variety of peripheral shapes for the aperture 44.

5 The elliptical shape of the 39 has been chosen to give a relatively stiff  
 6 blade as well as a continuous and smooth outer perimeter of the body. Hereby  
 7 the bodies of the blades will not interfere with one another when they are  
 8 displaced relative to one another even though the axial spacing of the bodies  
 9 is small. So as to avoid such mutual interference between the bodies as well as  
 10 between the pairs of arms 30a,b-33a,b it is advantageous that the radial  
 11 displacement of the bodies take place in such a manner that practically no  
 12 flexing of the arms takes place during such displacement, i.e. that the distance  
 13 between the ends of the arms of each pair is constant during such radial  
 14 displacement and that no torsional forces are exerted on the arms during such  
 15 radial displacement.

16 In the currently preferred embodiment of the invention shown in Figs.  
 17 1-9, this is achieved as follows:

18 Each arm is provided with an angled end portion 45 having a guiding  
 19 pin 46 extending therethrough and projecting from both opposed surfaces of  
 20 the angled portion 45. The plane of each end portion 45 is substantially  
 21 parallel to the plane of the body 38 of the respective blade.

22 The rings of each pair of rings, for instance 15 and 16 in Fig. 6 or 9  
 23 and 10 in Fig. 8-9, are identical, and one lateral surface of each ring is  
 24 provided with a recessed circumferentially extending track 47 in the bottom of  
 25 an annular circumferentially extending recess 48 and an elongate radially  
 26 extending track 49 in the bottom of an annular circumferentially extending  
 27 recess 50 identical to the recess 48 and arranged diametrically opposite the  
 28 recess 48.

1       The two rings 15, 16 in Fig. 6 and the two rings 9, 10 in Figs 8 and 9  
2   are arranged abutting each other with the lateral surfaces thereof provided  
3   with the recesses 48 and 50 facing one another such that the recess 48 of the  
4   ring 15 (ring 9) faces and overlies the recess 50 of the ring 16 ( ring 10), and  
5   the recess 50 of the ring 15 (ring 9) faces and overlies the recess 48 of the ring  
6   16 (ring 10). Hereby annular channels 51 for receiving the angled end  
7   portions 45 of the arms are formed when the rings of a pair 9/10, 11/12, 13/14  
8   or 15/16 are arranged abutting each other.

9       One of the two projecting ends of each guiding pin 46 of each end  
10   portion 45 is inserted in the circumferential track 47 of one ring of a pair of  
11   rings while the other projecting end is inserted in the radial track 49 of the  
12   other ring of said pair of rings.

13       The geometries of the tracks 47 and 49 are such that when one ring of a  
14   pair of rings is rotated relative to the other ring of the pair, then the respective  
15   body 38 of the blade carried by the pair of rings in question is displaced  
16   radially such that the distance between the pins 46 of the two arms of the  
17   respective blade remains constant and the arms are not subjected to any  
18   torsional stresses.

19       In Figs. 8 and 9 the ring pair 9/10 is shown with the ring 9 abutting and  
20   overlying the ring 10. In the illustration both rings are shown in full lines for  
21   the sake of clarity and to illustrate the relative positions of the tracks 47 and  
22   49 of both rings.

23       In Fig. 8 the ring 10 has been turned 10 degrees clockwise such that the  
24   track 47 thereof shown at left in Fig. 8 is turned 10 degrees clockwise, while  
25   the ring 9 has been turned 10 degrees counterclockwise so that the track 47  
26   thereof shown at right in Fig. 8 is turned 10 degrees counterclockwise.  
27   Consequently the track 49 of the ring 10 shown at right in Fig. 8 is turned 10  
28   degrees clockwise while the track 49 of the ring 9 shown at left in Fig. 8 is  
29   turned 10 degrees counterclockwise. The angles clockwise and

1 counterclockwise are given relative to an initial position where the body 38 is  
2 at the halfway position between Fig.8 and Fig.9. The maximum periphery of  
3 the light beam is shown by the circle 52.

4 In Fig. 9 the ring 10 has been turned 10 degrees counterclockwise such  
5 that the track 47 thereof shown at left in Fig. 9 is turned 10 degrees  
6 counterclockwise, while the ring 9 has been turned 10 degrees clockwise so  
7 that the track 47 thereof shown at right in Fig. 9 is turned 10 degrees  
8 clockwise. Consequently the track 49 of the ring 10 shown at right in Fig. 9 is  
9 turned 10 degrees counterclockwise, while the track 49 of the ring 9 shown at  
10 left in Fig. 9 is turned 10 degrees clockwise.

11 All intermediate positions between the two end positions shown in  
12 Figs. 8 and 9 are achieved by rotating the rings 9 and 10 relative to one  
13 another the corresponding amount of degrees between zero and twenty.

14 A multitude of different beam periphery shapes may be achieved by  
15 displacing the blades 30-33 radially by rotating the two rings of the  
16 corresponding ring pair relative to one another and by displacing the blades  
17 circumferentially by rotating the two rings of a ring pair together.

18 In Fig. 7 one of infinitely many combinations of radial and  
19 circumferential positions of the four blades 30-33 is shown, whereby a beam  
20 44 with the shown eight sided polygonal peripheral shape is achieved.

21 So as to achieve a distance between the two pins 46 at the ends of the  
22 two arms of each of the blades 30-33 that is the same for all radial  
23 displacements of the body 38 thereof, and so as to provide that no torsion of  
24 the arms takes place such that the body 38 is not subjected to any distorting  
25 forces, the shapes of the tracks 47 and 49 are configured accordingly as  
26 described in the following, with reference to Fig. 10 which illustrates the  
27 construction and calculation of the said shapes of the tracks 47 and 49.

28 In Fig. 10 three pairs of mutually corresponding points on the curves  
29 47 and 49 are constructed, the angles being exaggerated for the sake of clarity.

1 The construction of the curves is carried out according to the  
2 following:

3 A1 is constant and equal to half the distance between the two pins 48  
4 of a blade.

5  $C2 = A1$

6  $\text{Angle1} = \text{Angle2}$

7  $\text{Angle1} + \text{Angle2} = \text{Angle3}$

8 Both triangles are right-angled triangles

9 Angle 1 is the angle at which ring 1 is set, and Angle 2 is the angle at  
10 which ring 2 is set

11 By rotating ring 1 relative to ring 2, Angle 3 is obtained. A center line  
12 is constructed from the center of the rings and horizontally to the left such that  
13  $\text{Angle 1} = \text{Angle 2}$ .

14 Angle 1 and Angle 2 are used to construct two triangles.

15 A line is drawn along the center line, the line having a length equal to  
16 half the length between the two pins 46 of a blade.

17 This line forms the hypotenuse C2 as well as the triangle side A1 so  
18 that the other triangle side B1 can be constructed by drawing a line from the  
19 right angle downwards and C1 away from the center until the two lines  
20 intersect at a point. This point is on the curve to be constructed for configuring  
21 track 47.

22 Equation 1.1:  $B1 = \text{SIN}(\text{Angle 1}) \times A1$

23 Equation 1.2:  $C1 = A1 / \text{COS}(\text{Angle 1})$

24

25 C1 is now a radius which together with Angle 3 may be used to construct  
26 the track by means of the equations 1.3:

27  $X_{\text{track47}} = \text{COS}(\text{Angle 3}) \times C1$

28  $Y_{\text{track47}} = \text{SIN}(\text{Angle 3}) \times C1$

29 Or the equation 1.2 may be inserted in the equation 1.3:



$$X_{track47} = \cos(\text{Angle } 3) \times (A1/\cos(\text{Angle } 1))$$

$$Y_{track47} = \sin(\text{Angle } 3) \times (A1/\cos(\text{Angle } 1))$$

The X and Y axes are as indicated in Fig. 10 for each point constructed.

The track 49 in one ring extends in the radial direction to take up the radial displacement of the corresponding end of the pin 46 arising from the geometry of the track 47 in the other ring.

As it is the intersection point or triangle apex B1/C1 that alters its position relative to the center of the rings, the shape of the track 47 is given by:

$$X_{track49} = A1/\cos(\text{Angle } 1)$$

$$Y_{track49} = 0$$

such that the fixed distance is maintained between the ends of the pins 46 in corresponding points of tracks 47 and 49.

Those skilled in the art will readily appreciate that it is possible to achieve displacement of beam shaping blades radially and circumferentially by means of rotating rings in many other ways.

Referring now to Fig. 11, an alternative way of arranging the beam shaping blades is shown schematically. Two adjustment rings 56, 57 similar to the adjustment rings 9,10 of Figs. 8 and 9 are arranged abutting each other with a beam shaping blade 60 arranged therebetween and attached to the rings by means of two guiding pins 61 and 62. The pin 61 is received in a recess in the lateral surface of the ring 57 facing the ring 56, the recess having a shape that only allows rotation of the pin 61 therein. The pin 62 is received in a linear track 63 recessed into the lateral surface of the ring 56 facing the ring 57. The pin 62 may slide in the track 63.

The situation wherein the blade 60 maximally obstructs the beam of light 52 is shown in full lines while the situation wherein the blade 60 does not obstruct the beam 52 is shown in dotted lines. The fully obstructing

1 position of the blade 60 is amended to the non-obstructing position thereof by  
2 rotating the rings 56 and 57 relative to one another, for instance as shown by  
3 rotating the ring 56 counterclockwise and maintaining the ring 57 in the same  
4 position. Hereby the pin 62 will be forced to slide in the track 63 while the pin  
5 61 merely rotates such that the blade rotates around the pin 61. In the shown  
6 example a rotation of the ring 56 counterclockwise 12 degrees will result in a  
7 rotation of 22 degrees of the blade 60.

8 This arrangement of the beam shaping blades requires relatively stiff  
9 blades and/or relatively large axial spacing between the individual blades so  
10 that the blades will not interfere with or engage one another when being  
11 rotated.

12 Referring now to Figs. 2, 3, 12 and 13, the mechanism for displacing  
13 the focusing lens 22 and the zoom lens 23 along the longitudinal axis 19 is  
14 shown in partly exploded form. A holder 64 for the zoom lens 23 and a  
15 holder 65 for the focusing lens 22 are slidably arranged in tracks 66 and 67,  
16 respectively, in track rails so that the holders 64 and 65 may be displaced to  
17 and fro parallel to the longitudinal axis 19.

18 A bracket 68 is connected to each of the holders 64 and 65, only the  
19 bracket 68 for the holder 65 being visible. The brackets are each connected to  
20 a respective toothed belt 69 and 70 corresponding to the holders 65 and 64,  
21 respectively. The toothed belts are mounted on pulleys 71 and 72 rotatably  
22 mounted on the track rails 66, 67.

23 Each of the adjustment rings 17 and 18 (partly cut away for clarity in  
24 Fig. 12) are provided with lateral toothed portions 73 and 74, respectively, for  
25 engaging the teeth of the toothed belts 69 and 70, respectively, so that rotation  
26 of the ring 17 to and fro will cause displacement of the toothed belt 69 to and  
27 fro, and rotation to and fro of the ring 18 will cause displacement to and fro of  
28 the toothed belt 70. Hereby, the lens holders 64 and 65 may be displaced to  
29 and fro along the tracks 66 and 67 by rotation to and fro of the rings 18 and

1 17, respectively.

2 Hereby, a simple, precise and relatively silent displacement mechanism  
3 is achieved for adjusting the position of the lenses along the longitudinal axis.

4 When the lighting fixture 1 is oriented with the axis 19 thereof steeply  
5 inclined, i.e. pointing upwards or downwards steeply, the weight of the lenses,  
6 particularly the zoom lens 23, will tend to force the lens up or down from the  
7 desired and adjusted position, especially if vibration of the fixture takes place.  
8 This tendency can be curtailed or eliminated by introducing an inertia or  
9 braking in the displacement mechanism.

10 However, if the inertia is present constantly, for instance a constant  
11 brake force applied to the toothed belts, then displacement of the lens will  
12 require additional tangential force applied to the rims of the rings 17 and 18.  
13 Naturally, this is undesirable both for manual operation, requiring greater  
14 exertion of force by the operator's fingers, and for motorized operation,  
15 requiring a more powerful motor with attendant increases in costs and  
16 possibly noise.

17 The displacement mechanism according to the invention is provided  
18 with a braking function that only is effective when displacement of the lens is  
19 not taking place, i.e. the braking function is only in force when the rings 17 or  
20 18 are not being rotated. The principles of the selective braking mechanism  
21 according to the invention and described in the following are of course also  
22 applicable in other applications where a displacement of an object with  
23 subsequent braking of the object in the displaced position is desirable.

24 The selective braking mechanism (Figs. 12-13) according to the  
25 invention comprises the pulley 71, a locking wheel 90, a friction washer 91, a  
26 friction spring 92, a locking washer 93 and a locking sled 94. The spring 92  
27 presses the locking wheel 90 and the friction washer 91 against the pulley 71  
28 so as to create a suitable friction between the locking wheel 90 and the pulley  
29 71. The locking sled 94 is arranged between the two parallel lengths of the

1 toothed belt and for displacement to and fro in the plane of said toothed belt  
2 70, perpendicularly to said two parallel lengths. The locking sled is provided  
3 with locking teeth 94a and 94b for locking engagement with teeth at the rim  
4 of locking wheel 90 in a ratchet type action. If the locking sled 94 is in a  
5 central position, i.e. not displaced toward any of the two parallel lengths of the  
6 belt 70, then the locking teeth 94a and 94b will not engage the teeth of the  
7 locking wheel 90 so no friction brake is applied to the belt 70.

8         The dimension of the locking sled 94 perpendicular to the parallel  
9 lengths of the belt 70 is slightly longer than the distance between the common  
10 tangents of the pulleys 71 and 72 such that in the central position of the  
11 locking sled 94, the locking sled will press against the parallel lengths of the  
12 belt 70.

13         If tension is applied to one of the parallel lengths of the toothed belt 70  
14 because of the weight of the lens, said length will be tightened and the parallel  
15 length will be loosened whereby the locking sled 94 will be displaced from  
16 the central position to a lateral position where the respective one of the  
17 locking teeth 94a and 94b will engage the ratchet teeth of the locking wheel  
18 90, thereby applying frictional braking forces to the pulley 71 through the  
19 friction washer 91.

20         However, if tension in one of the parallel lengths of the belt 70 is  
21 caused by rotation of the ring 18 for axial displacement of the holder 64, then  
22 the displacement of the locking sled 94 from the central position thereof will  
23 not cause engagement of one of the locking teeth 94a or 94b with the ratchet  
24 teeth of the locking wheel 90 as the ratchet effect will cause the respective  
25 locking tooth to "ratchet" over the ratchet teeth.

26         Hereby, a selective braking mechanism is achieved whereby the brake  
27 effect is operative, when the weight of the lens tries to rotate the respective  
28 adjustment rings, but the brake effect is inoperative when rotation of the  
29 respective ring is carried out to displace the lens axially.

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1       It will be apparent to those skilled in the art that the principles of the  
2   above selective braking mechanism may be applied in all applications where a  
3   braking effect is required in one direction of force application and is not  
4   required in the opposite direction of force application.

5       The arrangement of the gobo or pattern 29 in the ring 8 and the iris 28  
6   in the ring 7 need not be described herein as it will be apparent to those  
7   skilled in the art that this can be done in many ways well known in the art.

8       For remote control of the adjustment rings it will also be readily  
9   apparent to those skilled in the art that an electrical motor with a pinion for  
10   each ring may be arranged such that the teeth of the pinion mesh with the  
11   teeth on the rim of the respective ring. The motors may for instance be firmly  
12   attached to the frame 6 or be spring biased so that any irregularities in the  
13   mounting of the rings and thereby the toothed rims may be taken up. Magnetic  
14   markers may be attached to the rings such that a sensing means may sense the  
15   marker and thereby precisely identify the position of the respective ring as a  
16   basis for the subsequent rotation thereof to a new setting of the respective  
17   beam influencing means.

18  
19